1984
AIR QUALITY
DATA SUMMARY

NIAGARA REGION

November, 1985

Ministry
of the
Environment

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West Central Region

1984 AIR QUALITY DATA SUMMARY

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Ministry of the Environment
Air Quality Assessment
Technical Support Section
West Central Region
November, 1985

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

This report summarizes the results of air monitoring in the Niagara area in 1984.

The Ministry of the Environment has conducted routine monitoring in the area since the early 1970's. The Air Management Program in Ontario is based on controlling man-made emissions to meet ambient air quality objectives, which in turn are based on known effects on health, quality of life or sensitive vegetation, whichever is most stringent. To achieve these objectives, sources of pollution are identified, their emissions evaluated and appropriate control measures are instituted. Ambient air monitoring is used to identify pollution sources, evaluate the need for controls and then determine whether controls have been successful.

In addition to monitoring specific industrial sources, monitoring of a more general nature is also carried out in various localities to ensure that air quality objectives are being met and to observe trends in air pollution.

MONITORING NETWORK

The Ministry of the Environment operates a network of monitors in the Niagara area in Niagara Falls, Fort Erie, Chippawa, Port Colborne, St. Catharines, Thorold, and Welland. The Air Pollution Index (API) is measured in St. Catharines and Niagara Falls. The API is used as a warning system to alert the public to elevated air pollution levels. It is derived from 24 hour average concentrations of sulphur dioxide and particulate matter measured at single monitoring stations in those cities. The combination of these two pollutants at high concentrations has been shown to be indicative of adverse health effects. Hourly concentrations of both pollutants are telemetered to a central computer facility in Toronto. The computer then calculates the index, a dimensionless number based on the following mathematical equations:

St. Catharines

$$API = 1.15\ (16.84\ COH + 138.4\ SO_2)^{.97}$$

Niagara Falls

$$API = 1.47\ (15.74\ COH + 131.7\ SO_2)^{.92}$$

where:
COH is the 24-hour average soiling index concentration expressed in coefficient of haze units.

SO_2 is the 24-hour average concentration of sulphur dioxide expressed in parts per million.

Values below 32 are considered acceptable. At 32, known as the advisory level and with a forecast of continued

unfavourable conditions, significant industrial sources may be asked to voluntarily curtail operations. At an API of 50, major emitters would be ordered by law to curtail some operations. At 75, further cutbacks would be required and at 100, all sources not essential to the public health and safety could be ordered to cease operations.

Meteorological data (wind and temperature) are measured near Allanburg. This station's wind data was utilized in a computer program known as a "pollution rose" - essentially a cross-tabulation of average hourly pollutant concentrations with wind direction classes. The data from this program are illustrated on various maps in this report and are a useful tool in determining the impact of any given source on a monitoring station. The length of each line of the "rose" is proportional to the average yearly concentration when the wind was blowing from that direction, meaning that the arrows of the rose point towards the source of the pollutants. The actual concentration values are shown on the maps.

POLLUTANTS MONITORED

Two basic types of air pollutants are measured-gases and particulates (dust).

a) Gases measured with continuous analyzers include:

- Sulphur Dioxide (SO_2) - mostly monitored near industrial sources but SO_2 is also a product of domestic space heating. Air quality criteria and their underlying limiting factors are:

  1-hour average - .25 ppm (vegetation effects)
  24-hour average - .10 ppm (health effects in conjunction with particulates)
  1-year average - .02 ppm (vegetation effects)

- Total Reduced Sulphur (TRS) - measured exclusively near industrial sources. The measurement includes hydrogen sulphide (H_2S), the "rotten egg" gas but also other sulphur compounds. There are no general criteria for TRS but a one-hour criterion of 20 ppb exists for H_2S:

  1-hour average - 20 ppb (odour)

- Carbon-Monoxide-(CO) - general ambient levels were measured in St. Catharines. The major source of CO is the automobile. Criteria for CO are:

  1-hour average - 30 ppm (health effects)
  8-hour average - 13 ppm (health effects)

- Ozone (O_3) - measured in St. Catharines to check general ambient levels. Oxidants are products of photochemical reactions involving oxides of nitrogen, hydrocarbons and sunlight and ozone accounts for most of the oxidants produced. The sources of the precursor pollutants are mainly industrial and automotive. Concentrations follow very definite annual and daily trends with highest levels occurring during the summer, and daily maxima usually occurring in mid-afternoon. Both patterns are directly related to temperature and the amount and intensity of sunlight. Ozone and its precursors can be transported over great distances and can be augmented by local sources. Most of the high levels measures in Southern Ontario each summer arrive from the United States. An objective for ozone is:

  1-hour average - 80 ppb (vegetation effects)

- Oxides of Nitrogen - general ambient levels were measured in St. Catharines. They are a product of high temperature combustion sources including the automobile. The most abundant oxides are nitric oxide (NO) and nitrogen dioxide (NO_2). Criteria exist only for NO_2:

  1-hour average - .20 ppm (odour)
  24-hour average - .10 ppm (health effects)

b) Particulates (dust) are measured by three methods, each relating to a different size range of particles.

- Dustfall - heavy material generally greater than 10 microns in size (one micron is one-millionth of a metre) that settles out of the atmosphere by gravity.

A plastic container is exposed for one month and the collected dust is weighed and expressed as a deposition rate of grams/square metre/30 days. The measurement is imprecise and observations are restricted to relatively local areas. Criteria are:

1-month average	- 7.0 g/m^2/30 days	(nuisance effects)
1-year average	- 4.5 g/m^2/30 days	(nuisance effects)

- Total Suspended Particulates (TSP) - measured with high volume (hi-vol) samplers near industrial sources and for general ambient observations. The particles range from submicron to about 50 microns in size. The hi-vol sampler draws air through a glass fibre filter for a 24 hour period. The exposed filter is weighed and the weight of solids collected is converted to an equivalent concentration in air. Units used are micrograms per cubic metre. The samplers run once every six days. Criteria based on health effects in conjunction with sulphur dioxide are:

24-hour average	- 120 ug/m^3	(health effects)
1-year geometric mean	- 60 ug/m^3	(health effects)

- Soiling Index (Coefficient of Haze) - measured by tape samplers which measure fine particles less than 10 microns. Industrial sources as well as general ambient air are monitored. Coefficient of haze tape samplers determine hourly soiling values. Air is drawn through a filter paper tape for one hour. A

beam of light is shone through the paper before and after the airborne particles are collected. The difference in light transmission is translated into a coefficient of haze (COH) unit. The paper type then advances and a new hourly sample is collected. The criteria shown below are based largely on correlations with total suspended particulate (TSP).

24-hour average - 1.0 COH's/100 linear feet of air
1 year average - .5 " " " " " " "

DATA ANALYSIS

Fort Erie

Sulphur dioxide was measured just outside Fort Erie on the shore of Lake Erie at station 27048, Niagara Public Works. The monitor was placed there in 1977 in response to complaints in the U.S. that SO_2 from the Nanticoke Industrial area was significantly impacting on the Buffalo area. However, levels have been very low with all criteria met as shown in Table 1. The pollution rose in Figure 1 indicates that highest averages occurred with south and southeast winds, both from areas in the United States. The Nanticoke area had little effect on the readings. Consequently, the monitor will be removed in 1985.

Niagara Falls

The Air Pollution Index (API) Station (27056) on Allendale Avenue, near the Falls tourist area reached a maximum API of 20 on December 11. API's in St. Catharines and Hamilton were also elevated on this day at 20 and 37 respectively. Normally however, the API was very low, averaging only 5 for the year.

Sulphur dioxide and soiling index concentrations at the Allendale Avenue station 27056 given in Tables 1 and 3 were generally low and met all objectives.

The pollution rose given in Figure 2 for sulphur dioxide shows the highest average for east winds indicating the influence of the Niagara Falls, New York industrial area. For soiling index in Figure 3, highest levels were from the southeast quadrant. This may indicate a small influence of the Norton Company in Chippawa located 3 km away. District

abatement staff have begun an investigation into this company's emissions for the purpose of developing a control program (see Chippawa). Another potential source of fine particles from the southeast direction could be traffic in the Falls tourist area.

Suspended particulates at API station 27056 were generally low and met the yearly objective (Table 7). One sample exceeded the daily objective on April 30 during a severe windstorm which caused elevated readings throughout the Region.

Station 27055 at Stanley St., Niagara Falls, 500 metres northeast of General Abrasive Ltd., completed its first full year of monitoring in 1984. This station contains SO_2 and TRS analyzers, soiling index tape sampler and a hi-vol. The data for SO_2 and TRS is given in Tables 1 and 2 and show mostly low levels. All objectives for sulphur dioxide were met (Table 1). In the case of TRS, there were 4 hours in which the objective for hydrogen sulphide was exceeded (Table 2). The pollution roses in Figures 4 and 5 indicate that General Abrasives is the primary source of both pollutants as both roses show peaks under south-southwest winds. The hi-vol at station 27055 measuring suspended particulates showed a worse situation as the yearly mean was very high at 103 ug/m^3 (Table 7). Although a severe deterioration seems apparent from 1983, it should be noted that the monitor was moved 500 metres closer to the plant in the previous year, ie., mid-1983. Concentrations in the last half of that year averaged 90 ug/m^3. A local fallout problem in the immediate vicinity of the plant is apparent as 24 out of 55 samples exceeded the objective in 1984. High levels best correlated with southerly winds, ie., probably from General Abrasive.

The soiling index tape sampler at 27055 which measures much finer particles than the hi-vol showed much lower concentrations, generally within criteria. Only one day exceeded the daily objective as given in Table 3. The pollution rose in Figure 6 indicates only a marginal contribution of fine particles from General Abrasive under south-southwest winds. Fallout from this plant would appear to consist primarily of large particles affecting a very localized area. The greatest impact on station 27055 soiling index as shown in Figure 6, is from the southeast, ie., likely from Cyanamid (to be discussed below). General Abrasive will be the subject of a survey during early 1986 by Abatement Staff. An emissions control program should be in place by the end of 1986 to address the particulate and hydrogen sulphide emissions.

Suspended particulates were also measured at Station 27053 at First and Bridge, 500 metres southeast of Cyanamid. The data in Table 7 show levels similar to 1983 with a geometric mean of 76 ug/m^3 and 14 samples out of 55 exceeding the daily objective. Highest levels best correlated with northwest winds (although weakly) indicating the influence of Cyanamid. As mentioned, the soiling index sampler at station 27055 northwest of the plant also showed an impact from Cyanamid (Figure 6). A preliminary survey of Cyanamid suggests there are operational rather than design defects contributing to particulate emissions. The company's operation is under investigation.

Chippawa

Station 27051 at Norton and Portage, 200 metres northeast of the Norton Company indicated that air quality problems near the plant still exist despite the installation of a tall stack in 1982. The station consists of SO_2 and TRS

analyzers. Hi-vol and dustfall measurements were also made in the area.

SO_2 and TRS data are summarized in Tables 1 and 2. Although all SO_2 objectives were met (Table 1) , the one-hour objective for hydrogen sulphide was exceeded 78 times during the year (Table 2). These incidents were not random, but mostly occurred in several short and long incidents, indicative possibly of upset conditions or other special plant operations.

A mobile survey was conducted in October to assess concentrations further downwind of the stack and found acceptable levels of SO_2 and TRS. A move of the station further downwind was contemplated, but based on the results of station 27051 and the mobile survey, the station will be left in place.

Pollution roses in Figures 7 and 8 clearly indicate the contribution of the Norton plant as both SO_2 and TRS roses show peaks under southwest winds.

Suspended particulate concentrations were measured at Station 27009 which is close to the main station 27051 at Norton and Portage. The yearly mean was 73 ug/m^3 exceeding the yearly objective, and 7 samples exceeded the daily objective (Table 7). The background hi-vol 27014 located 2 km southwest at Stanley and Chippawa showed much lower and generally acceptable levels.

Dustfall near the Norton plant at 27005, Portage and Legion exceeded the monthly objective in 6 out of 11 samples (Table 9). The background jar (27006) at Bridgewater and Oliver recorded much lower and generally acceptable levels. The Welland District office has advised Norton that emissions do

not meet requirements and has requested an abatement action plan from the company which may form the basis of a Control Order.

Port Colborne

Two hi-vols measuring suspended particulates near INCO (27030 and 27047) both recorded generally low and acceptable concentrations although slightly higher than in 1983 (Table 7).

Levels were higher at 27047 which is much closer to the plant at Davis and Fraser (being only 350 metres away) but still recorded only 3 excessive daily samples. Station 27030 located 1 km northeast of the plant at Killaly and James had one excessive sample but this was during a severe windstorm on April 30.

The samples were analyzed for nickel and one excessive concentration above the nickel objective (2 ug/m^3) was observed at 27047 (Table 8). None were measured at 27030. Similar to TSP, nickel concentrations were somewhat higher than in 1983.

It would appear that INCO's effect on air quality was fairly marginal and localized, however, past Phytoxicology Section surveys have demonstrated nickel contamination of vegetation in the area well above guidelines. Abatement staff is investigating the possible cause of nickel exceedences. No formal abatement program is scheduled for 1985-86 although the company will be requested to tighten emission controls where possible. If no improvement is evident in 1985, appropriate action will be scheduled for 1986-87.

St. Catharines

The API measured downtown at Station 27037, North and Geneva, reached a maximum of 24 on February 10. Another incident on November 27 reached 22. Both incidents occurred during light southeast winds. Elevated API's here are generally due primarily to soiling index rather than sulphur dioxide and are probably mainly due to local traffic emissions during poor dispersion conditions. Normally the index was very low, averaging only 5 for the year.

Concentrations of sulphur dioxide, carbon monoxide and nitrogen dioxide remained mostly unchanged and met all objectives at the API station (Tables 1,5 and 6). Soiling index levels were generally low (Table 3) but there was one excessive daily average during the February 10 API incident. Highest soiling index levels generally occurred during rush hours and/or during southeast winds (from Niagara St.) indicating that traffic is the main source.

Ozone concentrations were lower on average than in 1983 and showed only 19 hours above the objective compared to 116 hours in 1983 as shown in Table 4. This trend was observed through the Region and was probably due to a cooler summer with less bright sunshine. The higher levels usually occurred concurrently with other ozone monitors in Southern Ontario and normally occurred during south or southwesterly winds, downwind of sources in the United States.

Pollution roses for SO_2, soiling index, CO and NO_2 (Figures 9-12) all show highest averages during southeast winds probably pointing toward heavily travelled Niagara Street only 75 metres away.

The rose for ozone (Figure 13) shows its highest levels under south-southwest winds. This peak is not as prominent as might be expected since the rose is calculated for the entire year rather than just peak periods. As mentioned, most of the elevated ozone levels measured are probably a result of long range transport from the United States.

The hi-vol at the St. Catharines API station returned to more normal and acceptable suspended particulate concentrations following an unexplained peak in 1983 (Table 7). Only 2 samples were excessive including one during the April 30 windstorm. A short distance away, downtown on King St. at 27008, similar levels were measured and as a result this latter hi-vol was removed from service at the end of the year.

Dustfall near the Aimco Foundry at Plymouth Ave., Station 27040 (Table 9) deteriorated somewhat and continued to show elevated concentrations above objectives except winter months when snow cover may repress fugitive emissions. An extremely high April reading, probably due to the April 30 windstorm underscores the importance of fugitive emissions here. A survey of the Aimco Foundry has been completed identifying a number of emission sources. The company will be requested to submit an action plan before the end of 1985 including target dates for implementation.

Dustfall near the General Motors Foundry at Station 27041, Glendale and QEW, (Table 9) remained unchanged from 1983 and only two concentrations were excessive. With the exception of the occasional incident related to equipment failure, the G. M. Foundry is marginally acceptable. Abatement staff will continue to investigate particulate sources.

Dustfall near Burnstein Castings at Station 27054, Catherine and Russel, also remained unchanged and showed four excessive loadings including an extremely high April reading, probably due to the April 30 windstorm (Table 9). Fugitive emissions may be a problem here. The samples were analyzed for 10 metals, of which copper, zinc and iron were most prominent, implicating the foundry as the source. The company will be requested to submit an action plan before the end of the year to address fugitive emission sources.

Thorold

Sulphur dioxide measured at Station 27042, Niagara Falls Rd. and Ontario St., across from Ontario Paper Limited, improved greatly in 1984. Only 2 hourly readings marginally exceeded the objective and the daily and yearly objectives were met (Table 1). This compares to 125 hours and 13 daily averages exceeding criteria in 1983. The pollution rose in Figure 14 still indicates the influence of the paper mill, although the average from that direction was only .009 ppm. Both hourly excursions were due to emissions from the mill.

Dustfall near the paper mill is given in Table 9 and shows a corresponding improvement in the yearly average at station 27042, however, concentrations were still twice as high as at the background station 27043 at McAdam Park and sulphate contents were 3 times as high. Five samples exceeded the monthly objective at 27042, mostly during the spring. A Control Order is in preparation and includes provisions for further sulphur dioxide control, probably by 1986. Some operational deficiencies in the recovery furnace have been corrected which may result in improved dustfall loadings.

Station 27052 completed its first full year of monitoring. This stations is 100 metres northeast of Exolon on Queen St

and consists of a hi-vol, soiling index tape sampler and SO_2 and TRS analyzers. SO_2 and TRS data are summarized in Tables 1 and 2. All SO_2 objectives were met (Table 1), but TRS concentrations exceeded the hourly objective for hydrogen sulphide 567 times (Table 2). This figure may have been even higher were it not for instrumentation troubles which put the monitor out of service twice for a total of about 2 months.

The pollution roses in Figures 15 and 16 indicate the influence of Exolon as both peaked sharply under west-southwest winds from the plant.

Suspended particulates at station 27052 (Table 7) also showed extremely high levels with a geometric mean of 131 ug/m^3 (up from 115 in 1983) and 34 out of 57 samples exceeded the daily objective. Extremely high loadings were observed on April 30 (631 ug/m^3) and October 3 (498 ug/m^3), both days of very high winds, indicating that fugitive emissions from this plant were likely a problem. The soiling index tape sampler recorded mostly low levels of fine particulate with only one exceedence of the daily criterion (Table 3). The soiling index pollution rose in Figure 17 shows little impact from the plant. Particulate emissions would seem to consist mostly of heavy material not measured by the tape sampler.

The Exolon Co. is well ahead of schedule on a Program Approval to modernize the furnacing operation, which should result in significant reductions in suspended particulates and TRS. Monitoring in 1985 and 1986 will measure the success of the Program.

Welland

Suspended particulate concentrations near Union Carbide at station 27045, Alberta and Devon, (Table 7) increased

somewhat from the low levels measured in 1983. The yearly geometric mean was still below the objective, however, and only one sample exceeded the daily objective, occurring during the April 30 windstorm.

Occasionally elevated carbon contents (Table 8) continued to occur however, and these data and the suspended particulate results all correlated fairly well with southerly wind frequency, indicating Union Carbide was the major source of particulate in the area. The coal storage piles of this plant may be a source.

Dustfall in the area also increased slightly as shown in Table 9. Very high levels were observed at the base of Alberta Street, at Station 27035 near the coal piles mentioned, where eight samples exceeded the monthly objective. The other two monitors (27025-Harriet St. and 27026-Chaffey St.) recorded much lower levels with 3 excessive loadings between them. Unlike other locations, the April 30 windstorm did not create an excessively high April reading indicating that fugitive sources were well controlled. A high November reading, however, at 27035 did show some problems exist.

A report under Section 126 of the Environmental Protection Act has been prepared and submitted to the company for review. This will form the basis of a Control Order or voluntary program to be implemented in 1986.

DISCUSSION

This report has identified several local air pollution problem sources in the Niagara area. All are currently under investigation with a view to implementing control programs. Some control programs are already underway.

Apart from these localized problems, general air quality as characterized by our API (Air Pollution Index) stations in Niagara Falls and St. Catharines was quite acceptable. The advisory index level of 32 has never been exceeded at either of the two stations and both normally showed very low index readings, averaging 5 during 1984. They rarely exceed 20.

In the near future, (a timetable has not yet been set) a new air quality data telemetry system is to be installed throughout the Province. This new system will permit all of our stations with continuous analyzers to send data directly to our central computer facility in Toronto, allowing for data collection on a real-time basis. Currently, only the two API stations and the meteorological tower near Allanburg are telemetered to Toronto while the remainder of our stations require manual reading of strip charts for the data. This chart reading process causes delays in the availability of our data, amounting to several months. The new system will allow for immediate access to data as it occurs, both in the Regional Office in Hamilton and in Toronto and will also allow for remote control and maintenance of the instruments. All of this will result in a more efficient monitoring program.

Once the new system has been implemented, a new expanded Air Quality Index (AQI) will be added to of the current API which refers to only two pollutants. The AQI will be a function of six different pollutants, which will form up to 8 separate

subindices. Concentrations of sulphur dioxide, soiling index, carbon monoxide, nitrogen dioxide, total reduced sulphur and ozone will all be individually converted to the current scale of index numbers with the same advisory or alert levels of 32, 50, 75 and 100. Not all stations will measure all of the parameters, but the highest subindex and the pollutant causing it will be reported several times daily to the public. In the Niagara Region, the new AQI's will be reported for the existing St. Catharines and Niagara Falls API stations. The potential for additional communities reporting AQI's is possible in the future. We hope that the new index will better inform the people of Ontario about air quality.

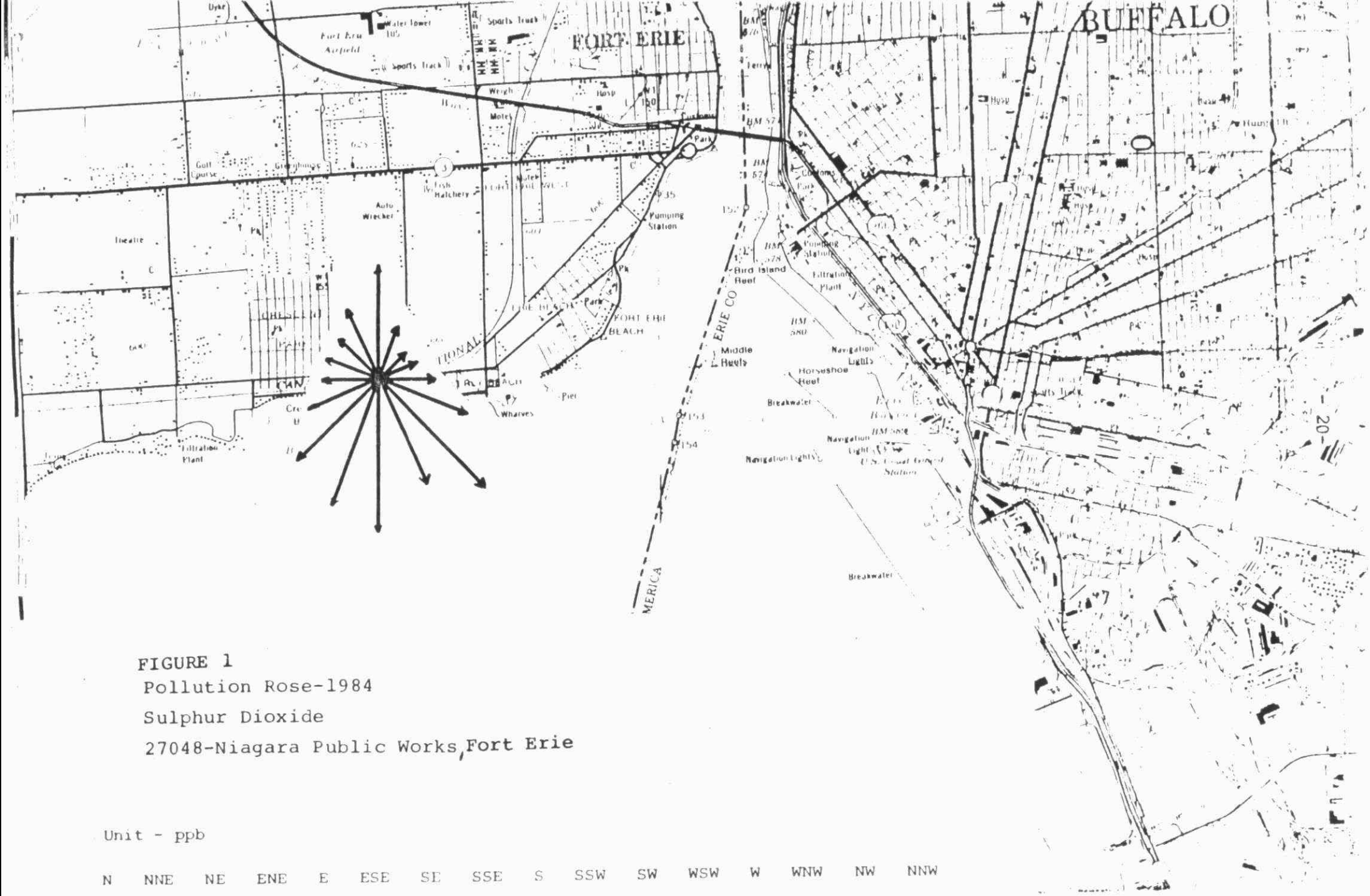


FIGURE 1
Pollution Rose-1984
Sulphur Dioxide
27048-Niagara Public Works, Fort Erie

Unit - ppb

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
6	3	2	3	3	5	8	6	8	7	6	4	3	3	4	4

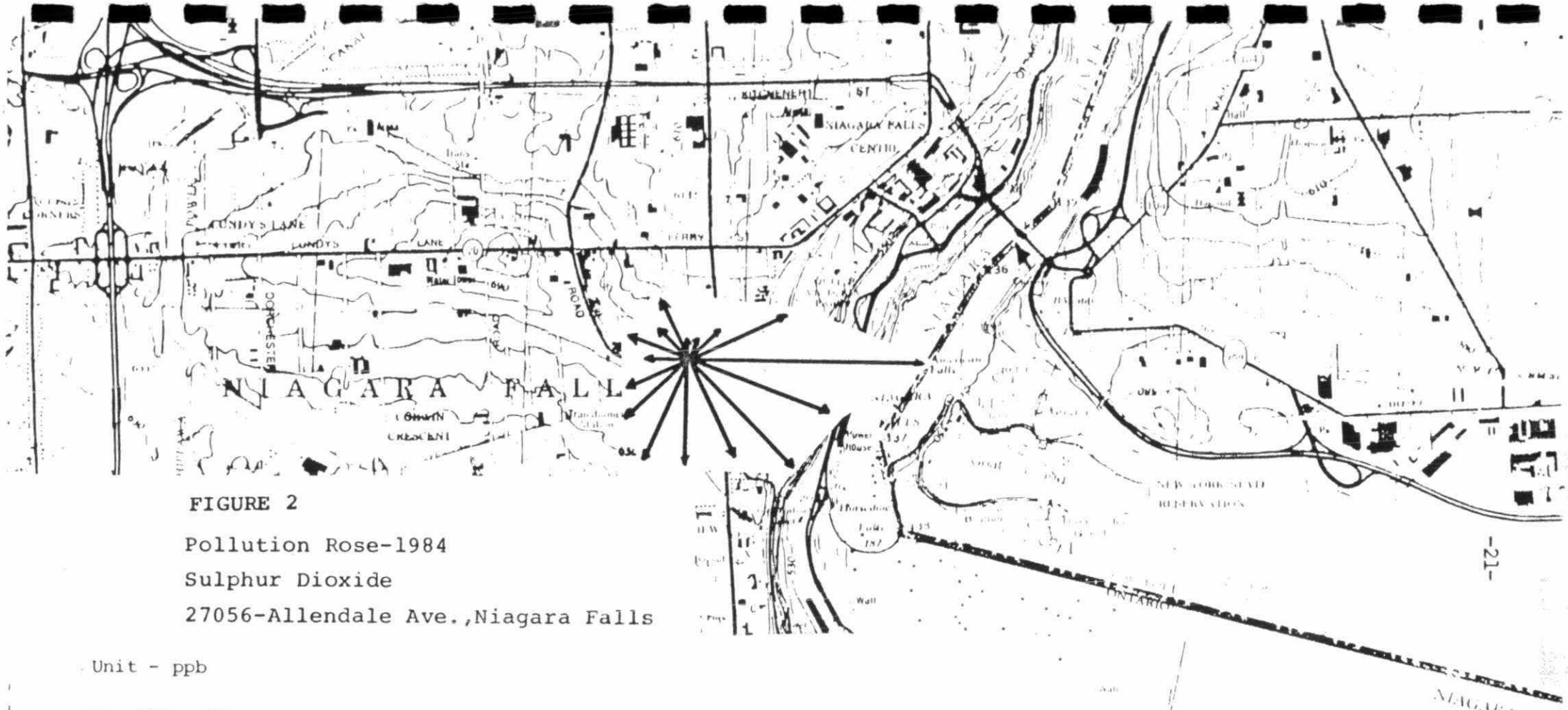


FIGURE 2

Pollution Rose-1984

Sulphur Dioxide

27056-Allendale Ave.,Niagara Falls

Unit - ppb

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	1	2	5	11	7	7	5	5	5	4	3	2	3	2	3

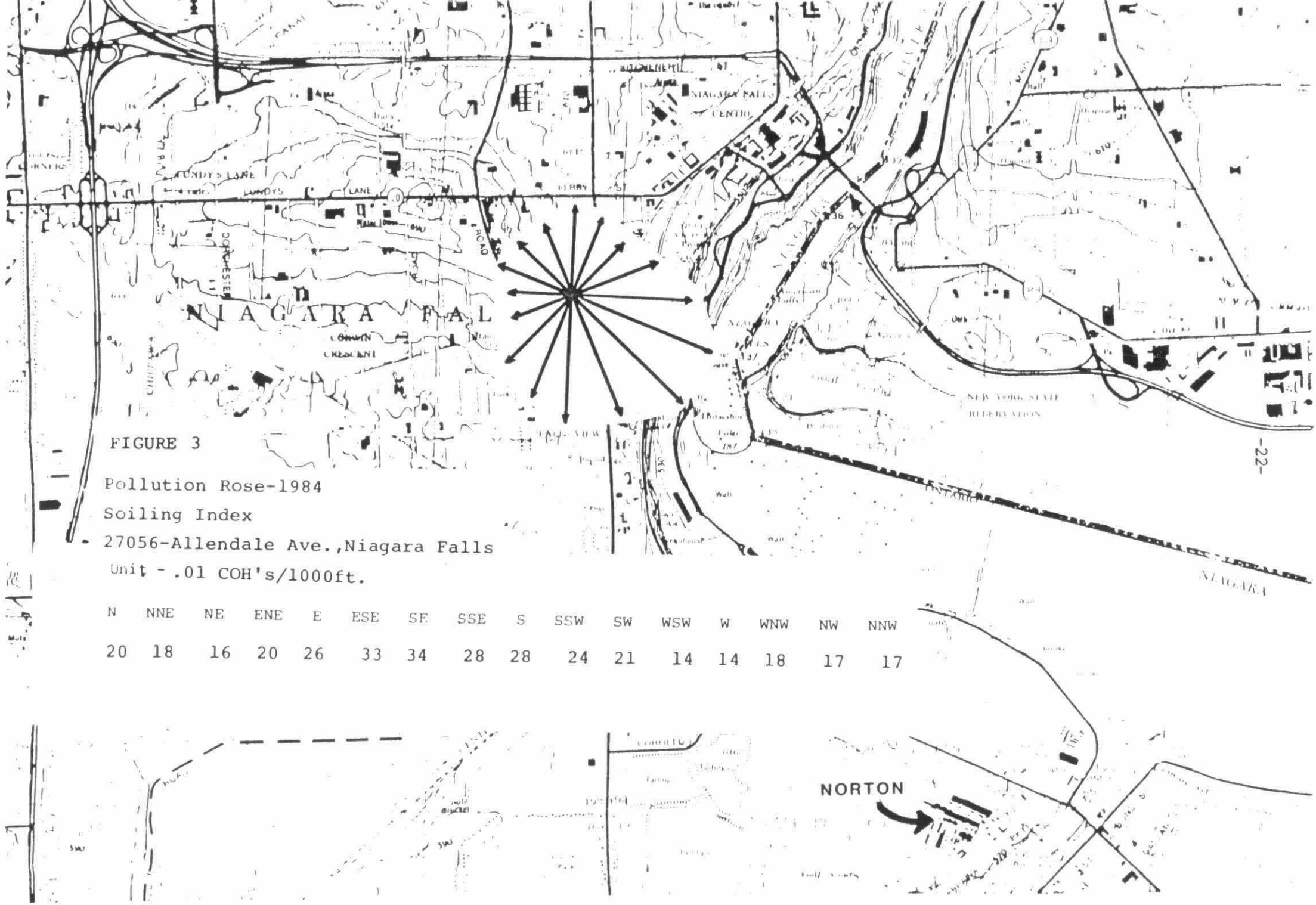


FIGURE 3

Pollution Rose-1984
Soiling Index
27056-Allendale Ave.,Niagara Falls
Unit - .01 COH's/1000ft.

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
20	18	16	20	26	33	34	28	28	24	21	14	14	18	17	17

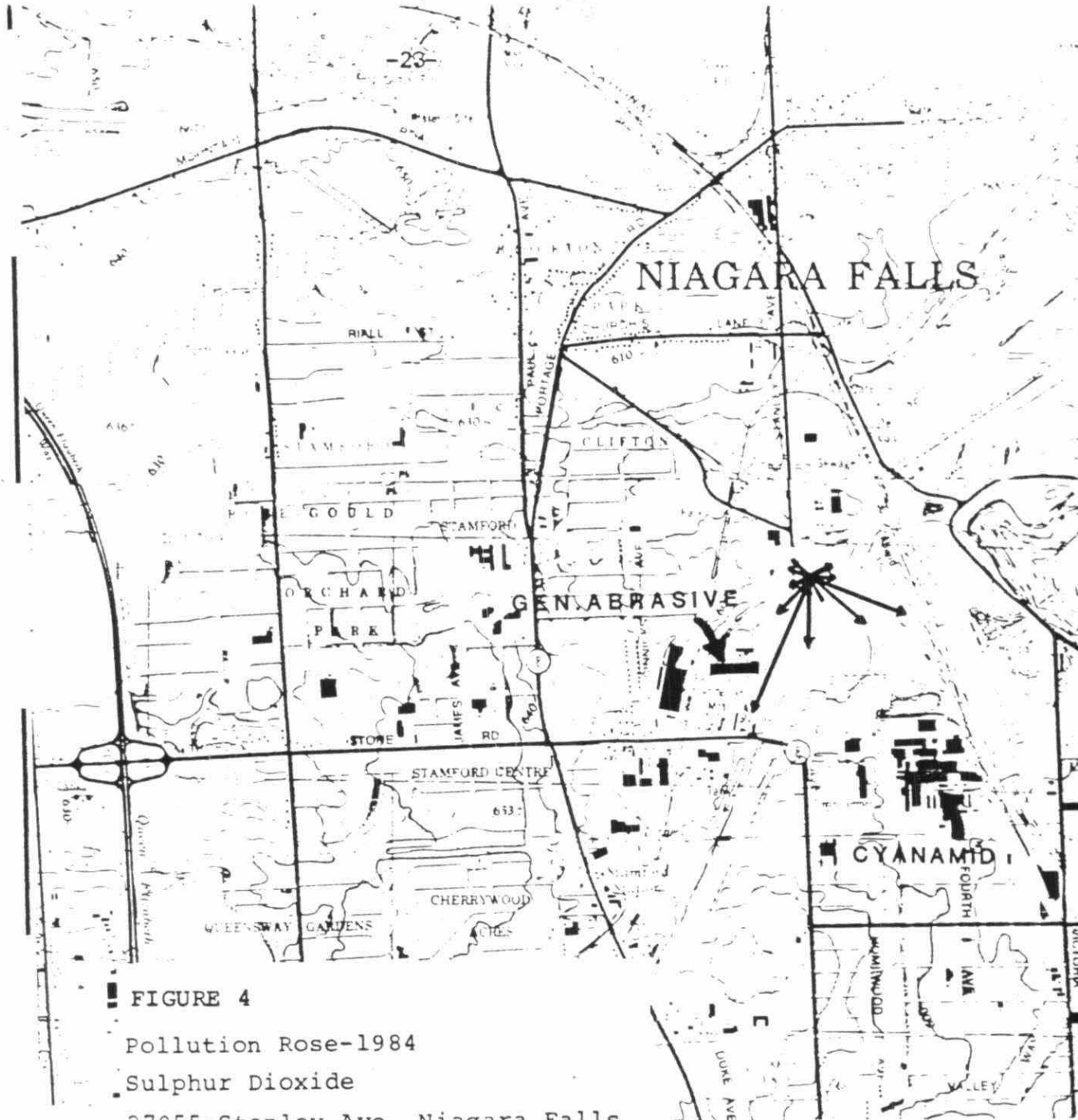


FIGURE 4

Pollution Rose-1984

Sulphur Dioxide

27055-Stanley Ave.,Niagara Falls

Unit - ppb

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
0	0	0	1	1	4	3	1	3	6	2	1	0	1	1	0

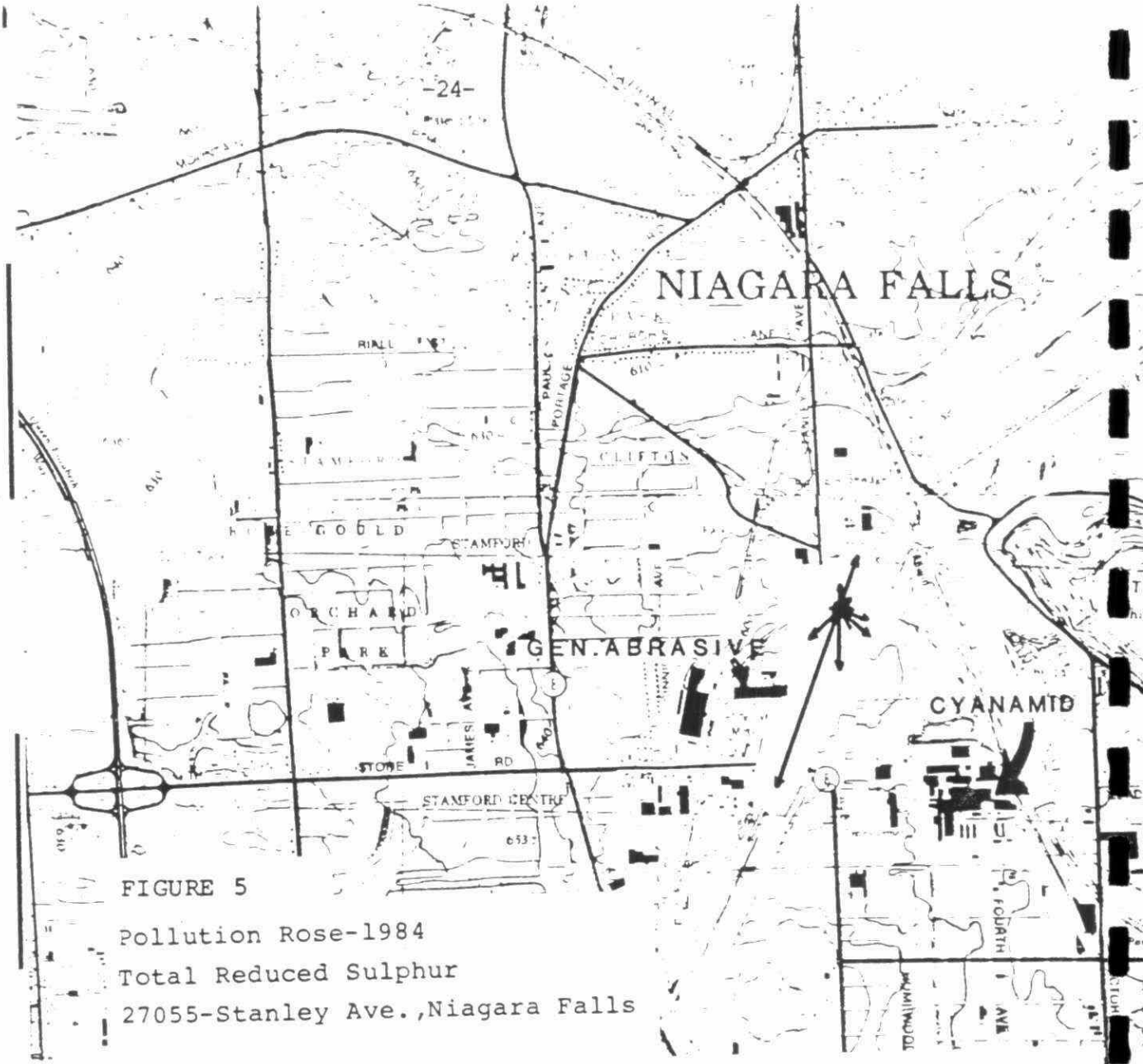


FIGURE 5

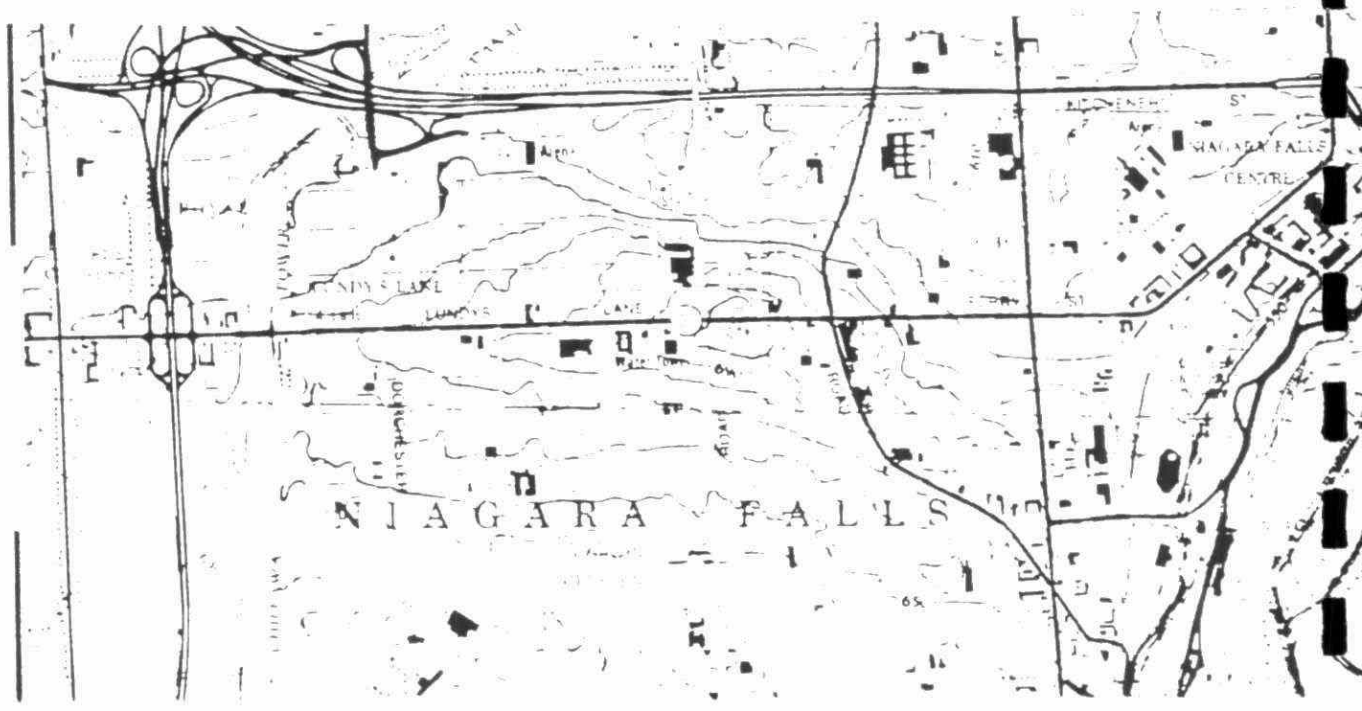
Pollution Rose-1984

Total Reduced Sulphur

27055-Stanley Ave.,Niagara Falls

Unit-.| ppb

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
4	9	2	1	2	4	6	3	10	30	7	1	2	2	1	2



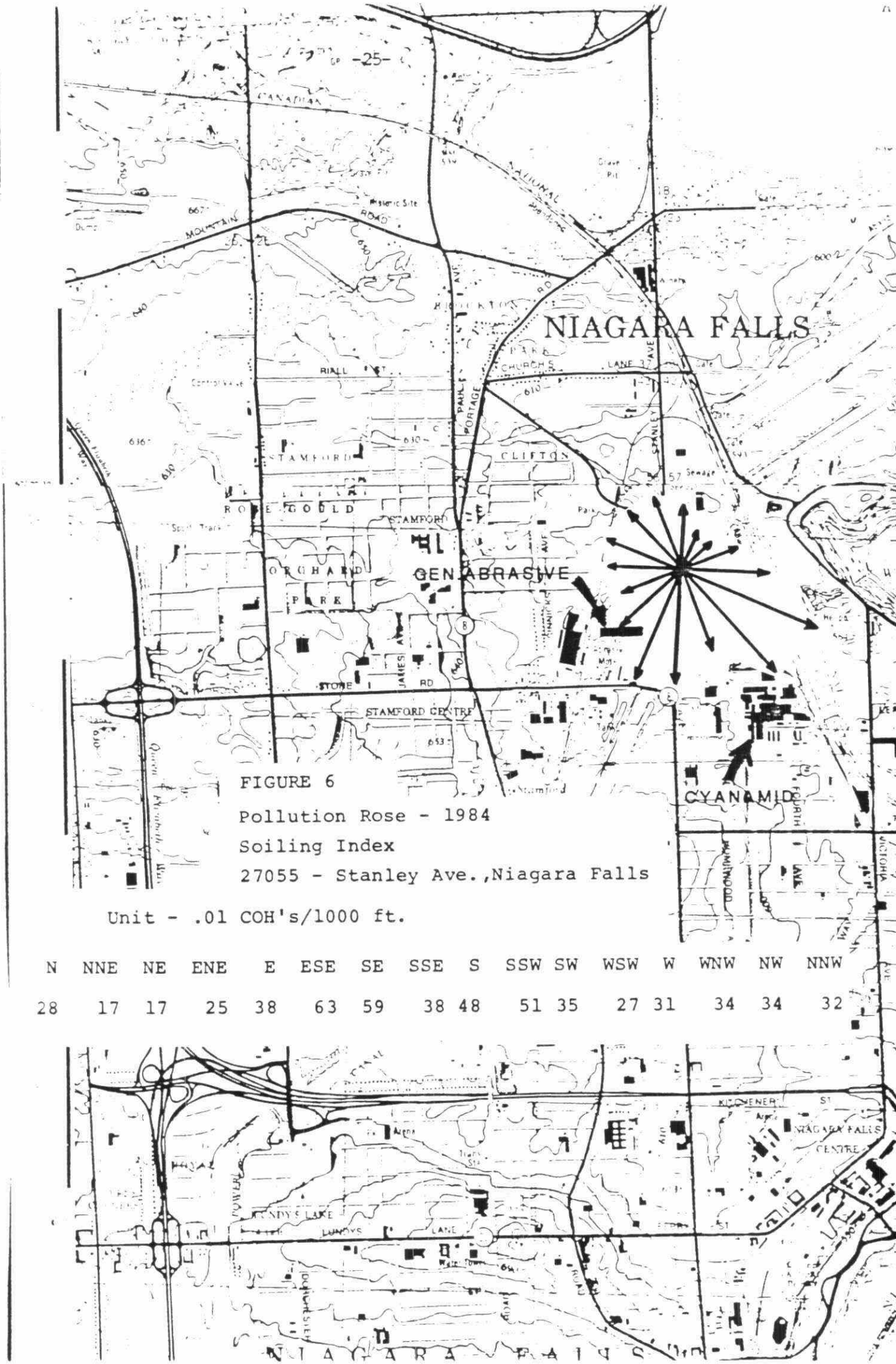


FIGURE 6

Pollution Rose - 1984

Soiling Index

27055 - Stanley Ave.,Niagara Falls

Unit - .01 COH's/1000 ft.

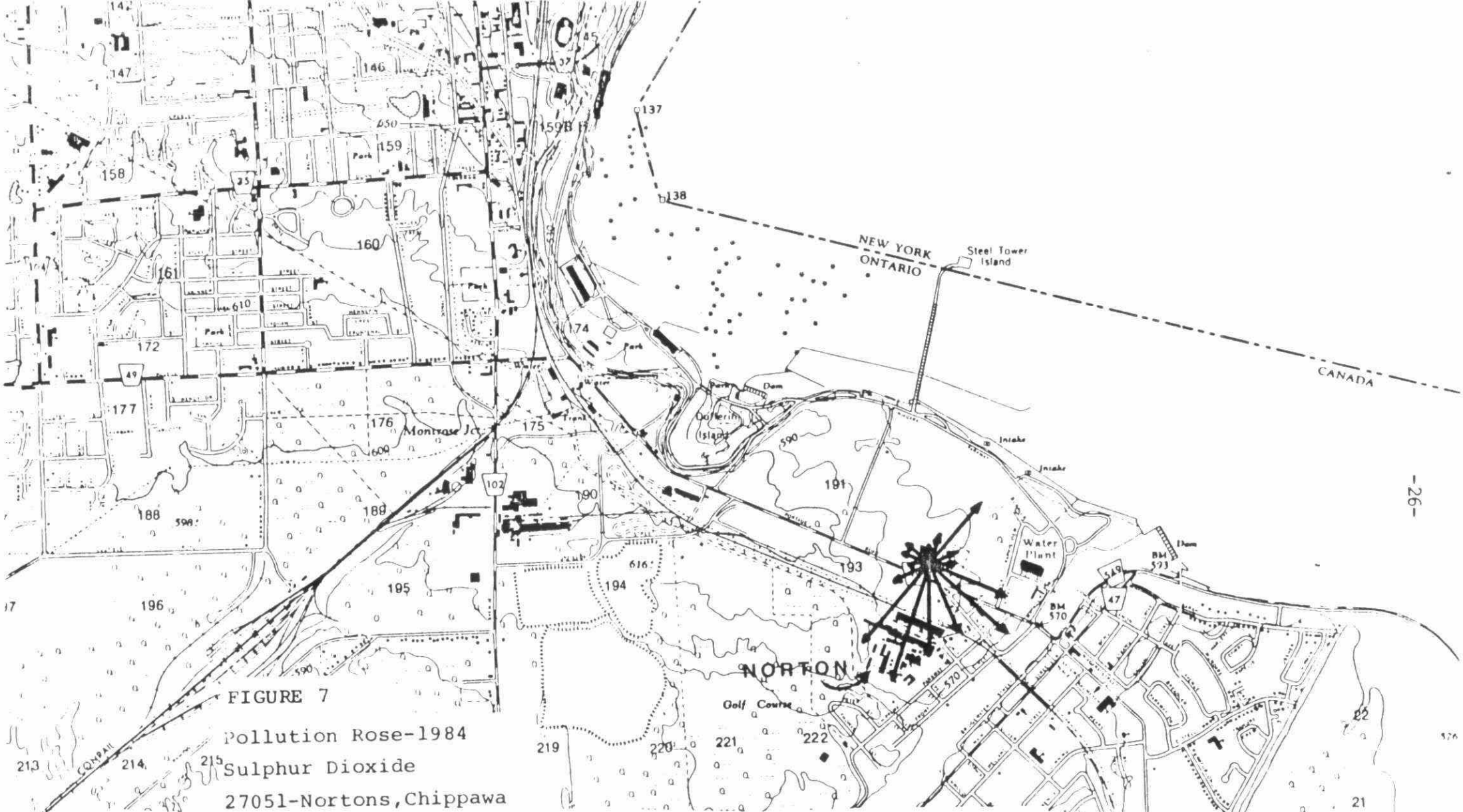


FIGURE 7

Pollution Rose-1984

Sulphur Dioxide

27051-Nortons,Chippawa

Unit- ppb

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
2	3	8	3	3	8	10	7	9	12	10	4	2	3	3	2

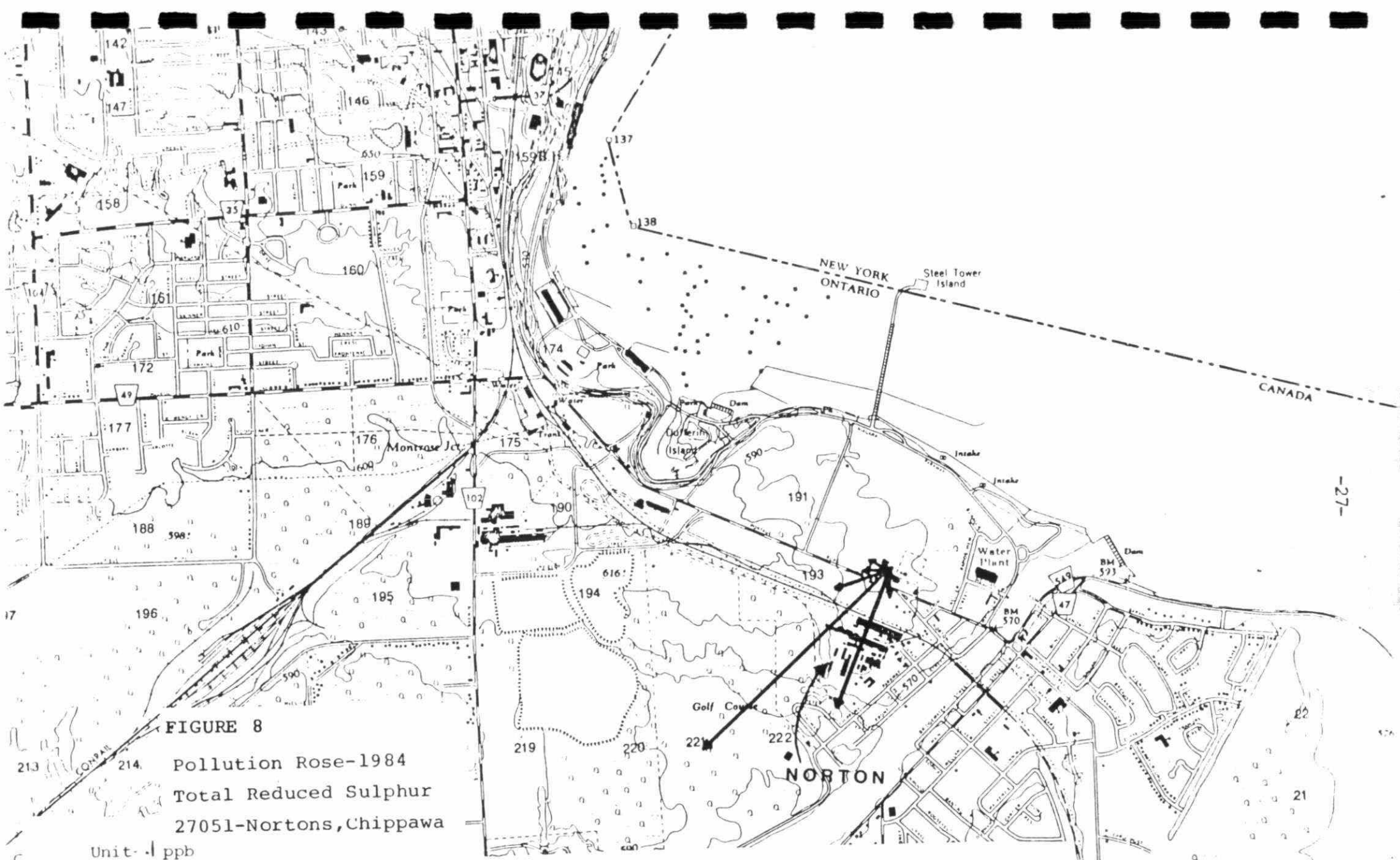


FIGURE 8

Pollution Rose-1984

Total Reduced Sulphur

27051-Nortons,Chippawa

Unit: ppb

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
0	0	1	0	0	2	3	1	5	30	53	11	5	5	2	1

FIGURE 9

Pollution Rose-1984

Sulphur Dioxide

27037-North/Geneva,St.Catharines

Unit- ppb

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
2	2	3	4	7	10	12	8	7	6	6	3	3	4	4	2

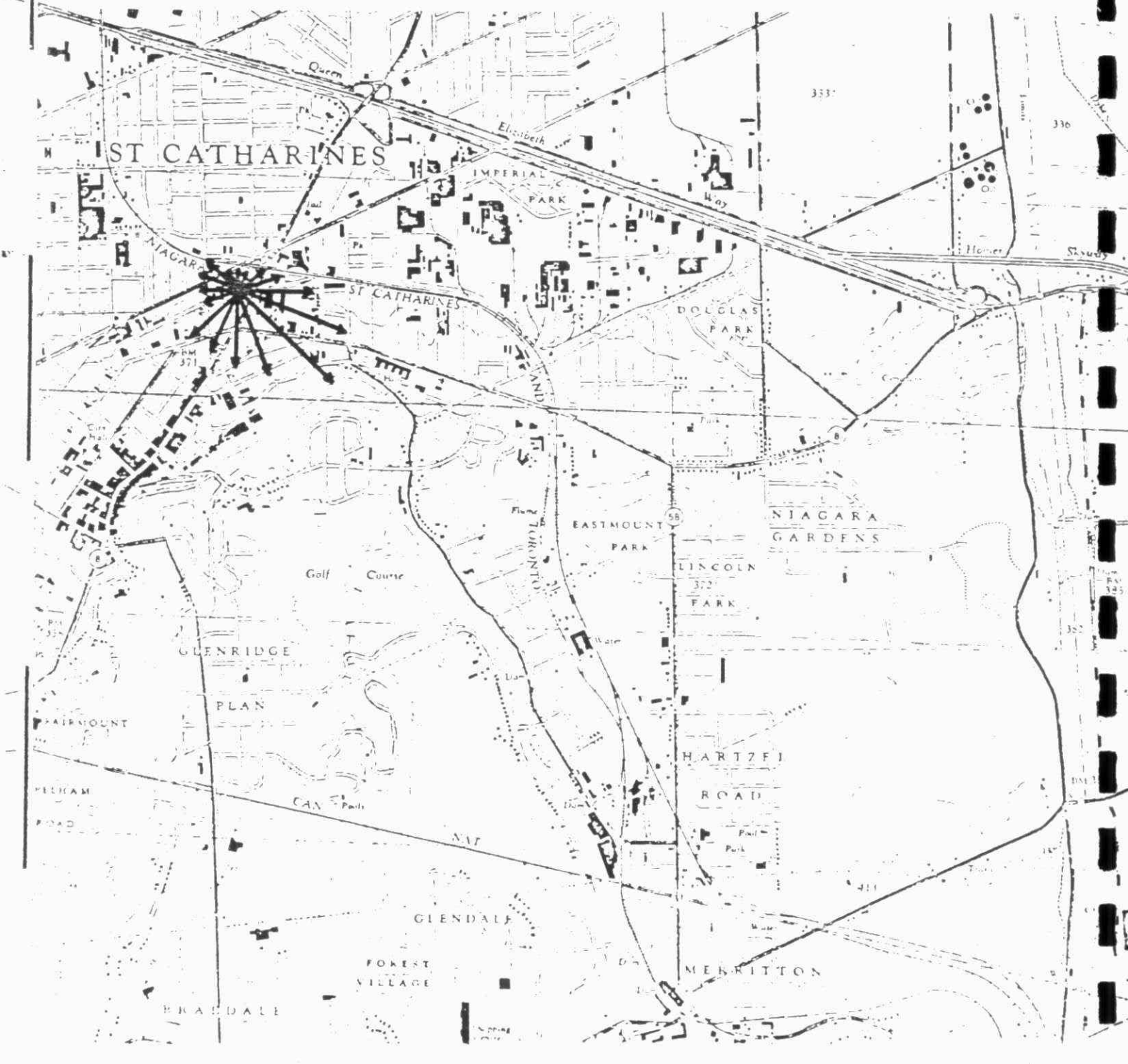


FIGURE 10

Pollution Rose-1984
Soiling Index
27037-North/Geneva,St.Catharines
Unit- .01 COH's/1000ft.

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
21	22	22	22	29	44	45	35	32	25	20	14	16	20	19	17

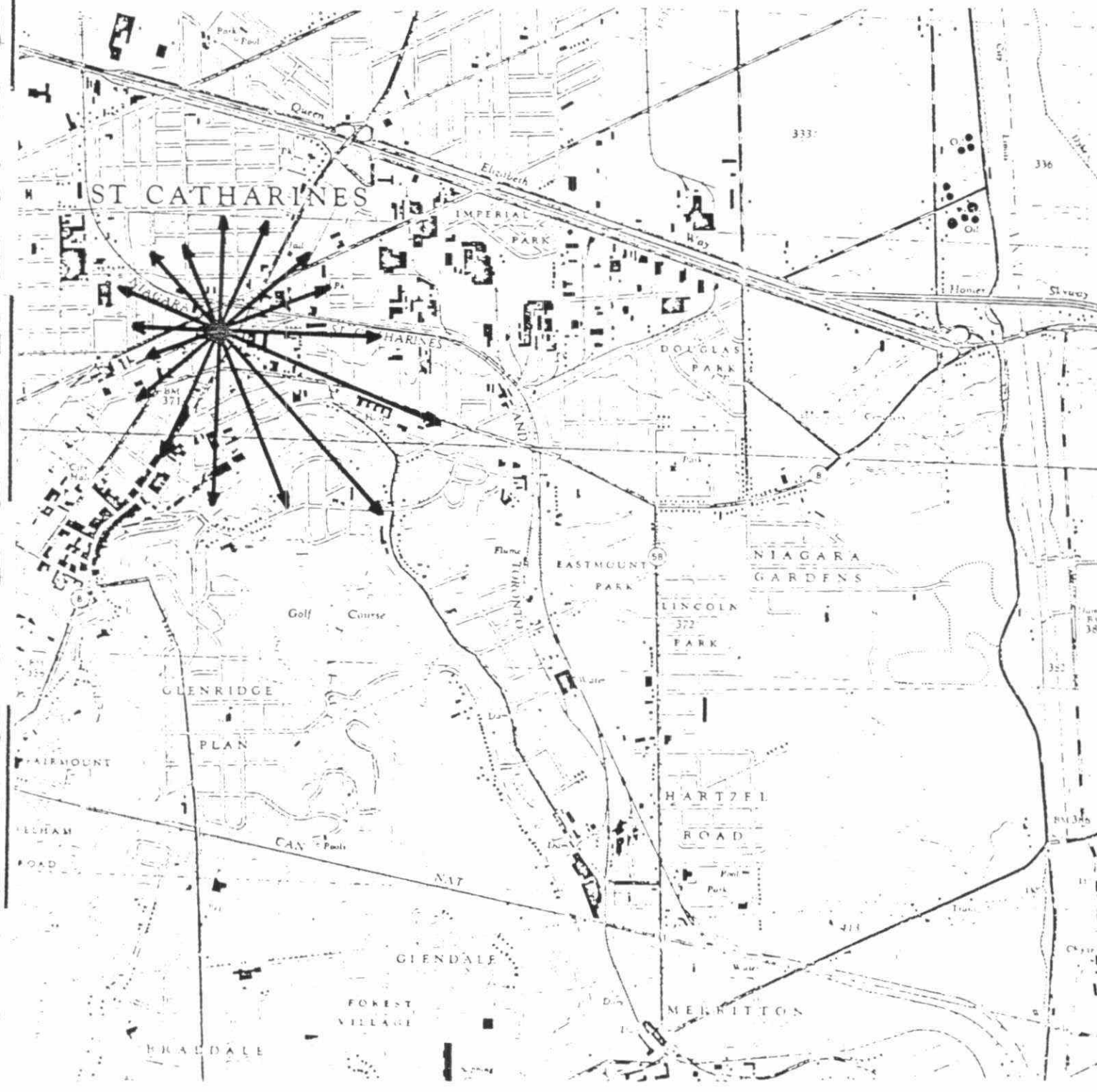


FIGURE 11

Pollution Rose-1984

Carbon Monoxide

27037-North/Geneva,St.Catharines

Unit-.1 ppm

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
3	4	3	3	4	7	8	5	4	3	2	2	2	3	3	3

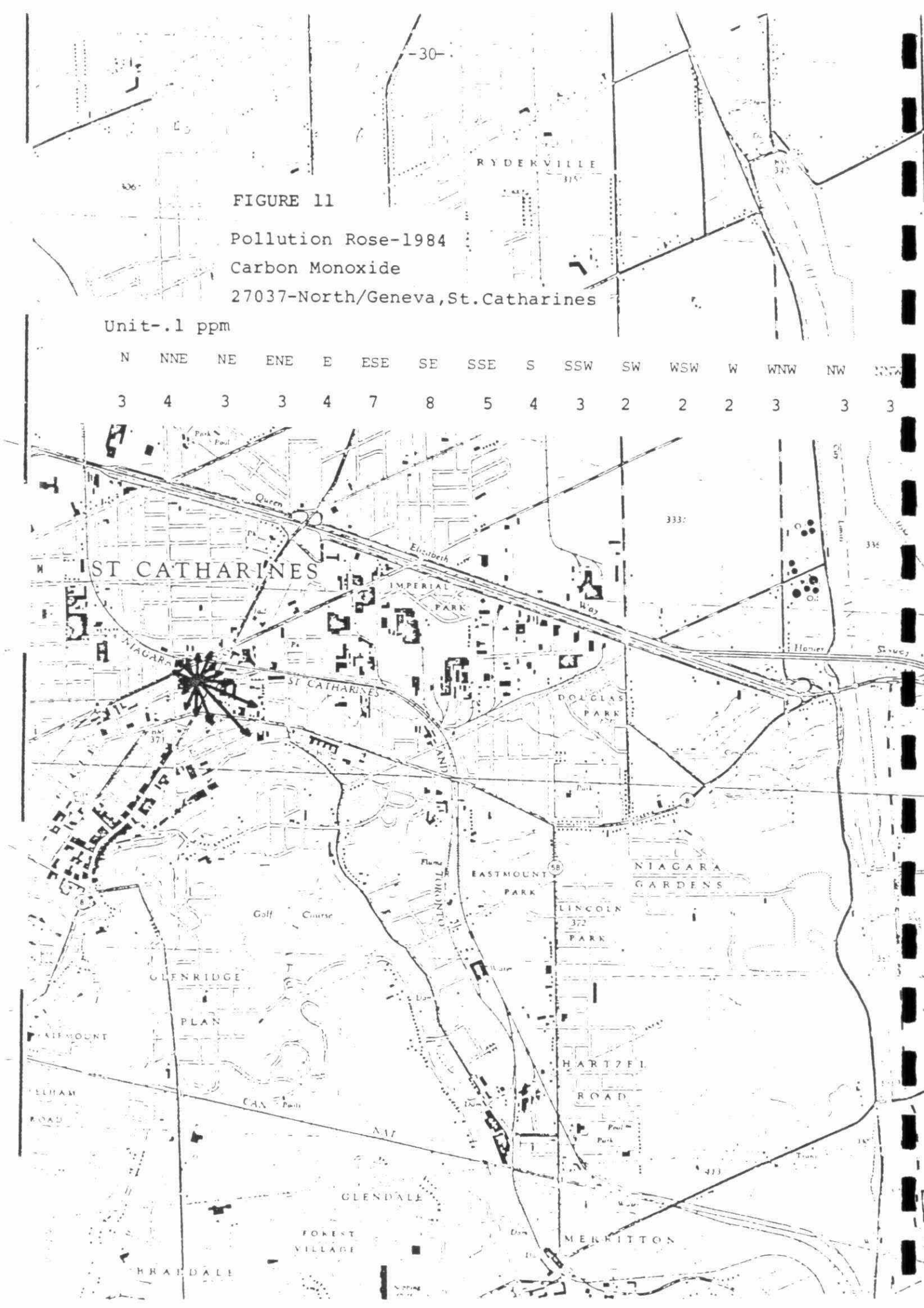


FIGURE 12

Pollution Rose-1984
Nitrogen Dioxide
27037-North/Geneva,St.Catharines

Unit - ppb

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
16	16	15	17	22	26	26	22	19	18	16	14	15	17	18	16

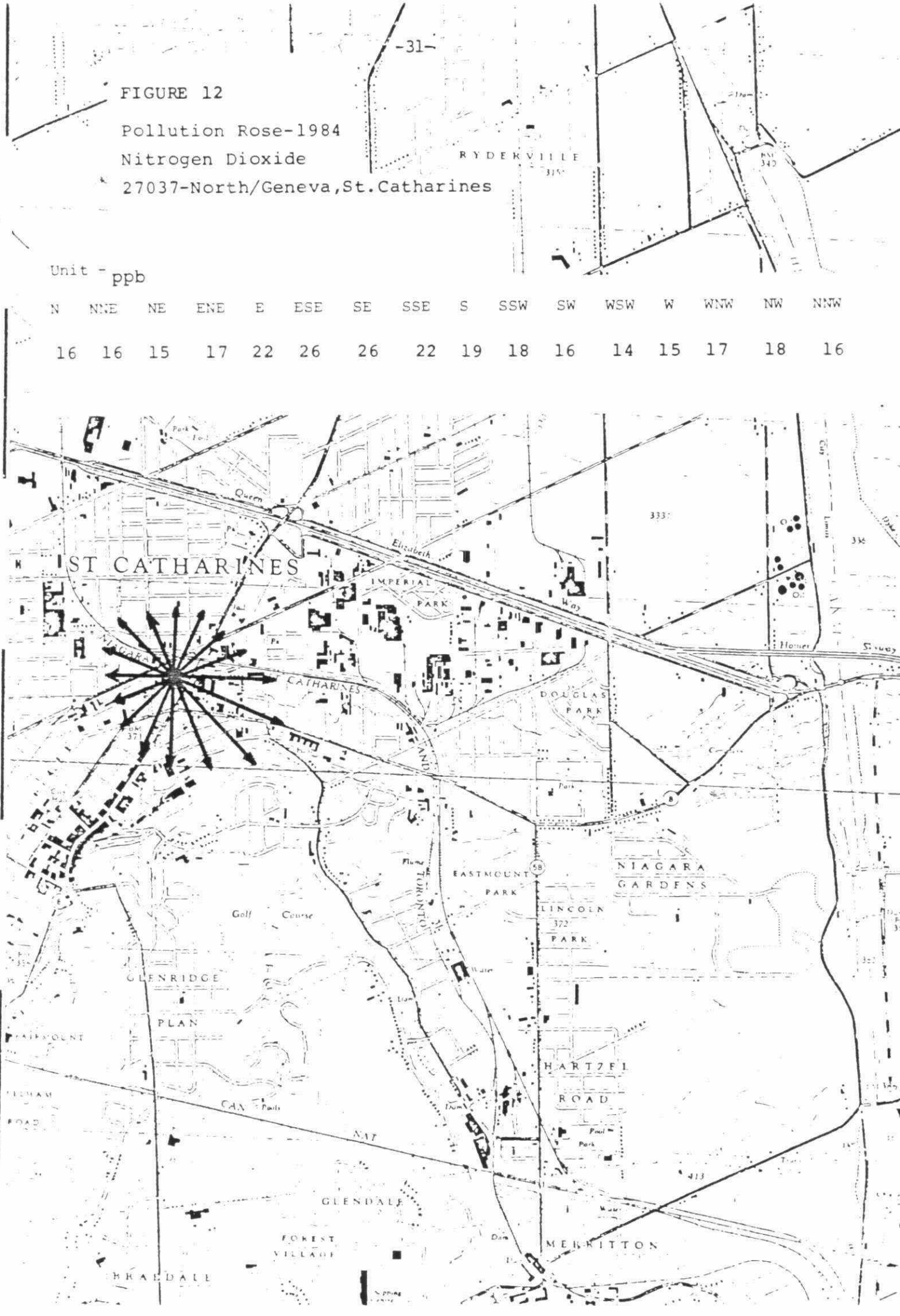


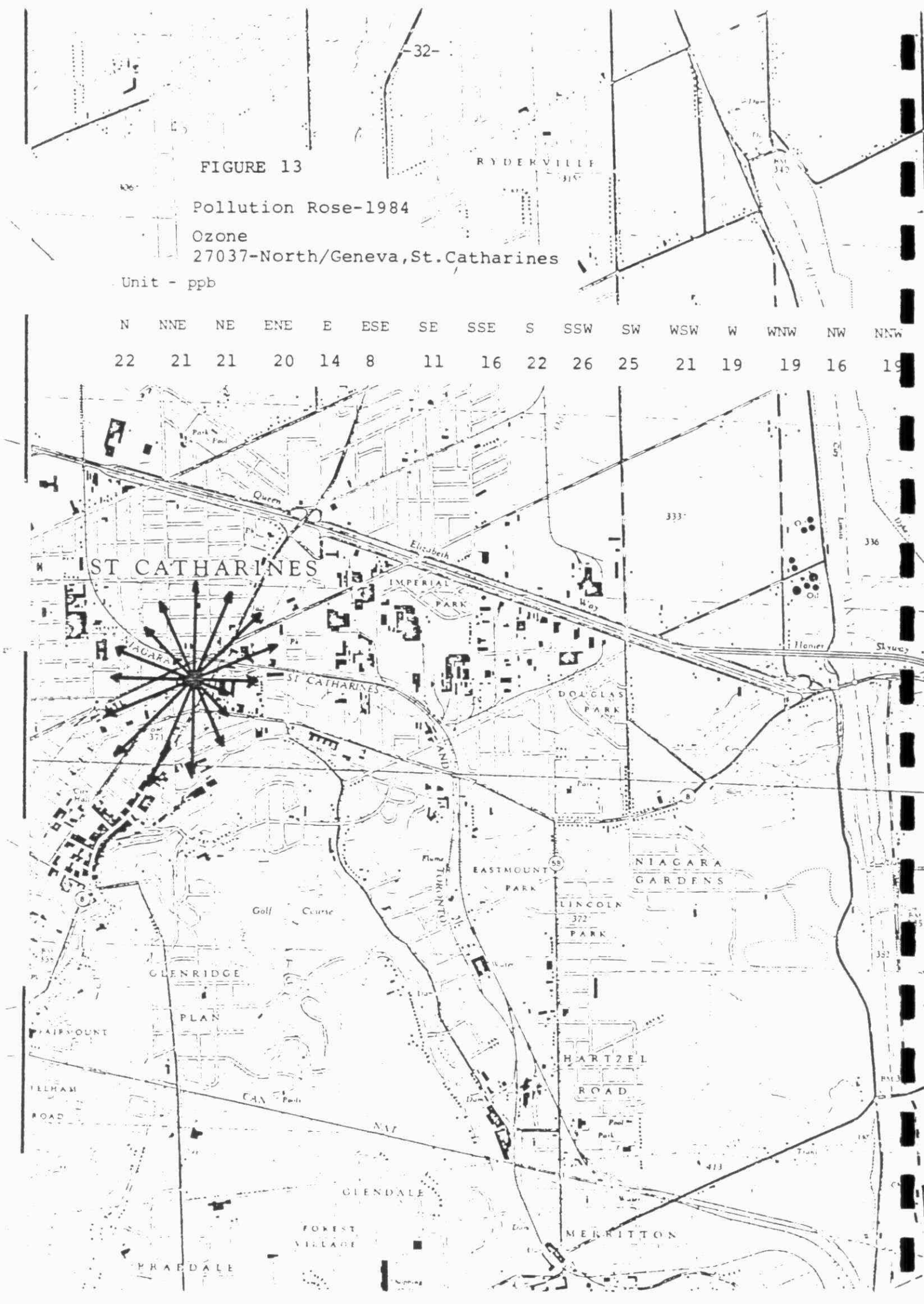
FIGURE 13

Pollution Rose-1984

Ozone
27037-North/Geneva,St.Catharines

Unit - ppb

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
22	21	21	20	14	8	11	16	22	26	25	21	19	19	16	19



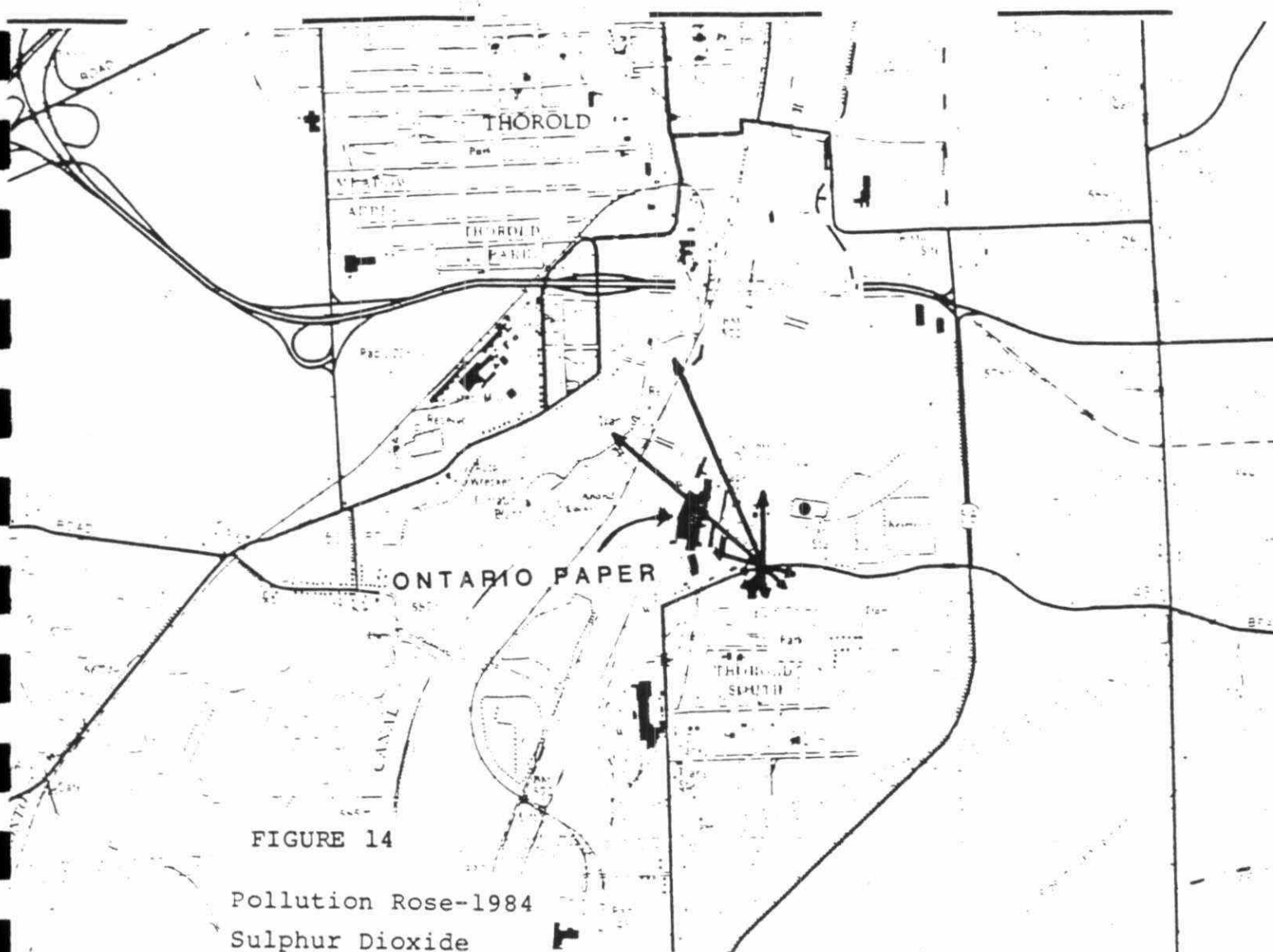
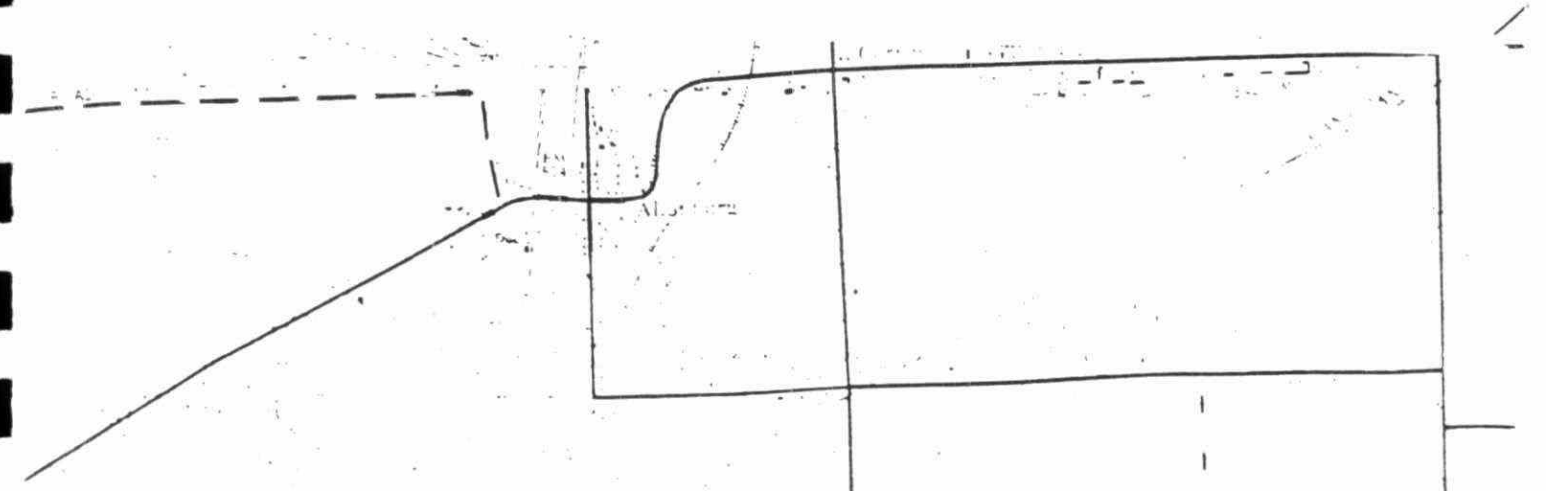


FIGURE 14

Pollution Rose-1984
Sulphur Dioxide
27042-Niagara Falls Ave./Ontario St.,Thorold

Unit - ppb

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
3	0	0	0	0	1	1	0	1	1	1	0	1	2	8	9



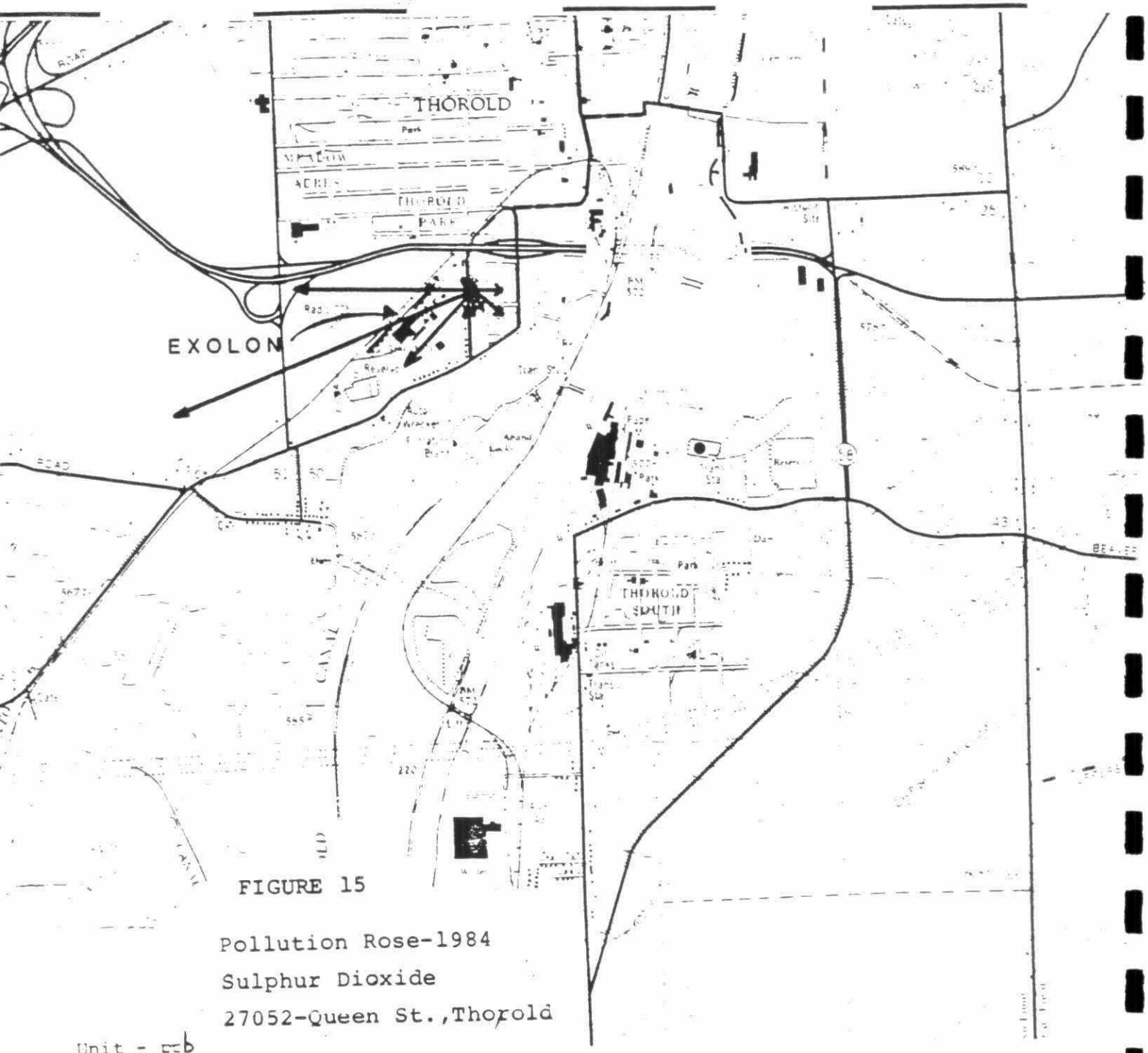


FIGURE 15

Pollution Rose-1984
Sulphur Dioxide
27052-Queen St.,Thorold

Unit - ppb

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	1	1	2	5	11	7	4	5	5	18	57	32	5	3	1

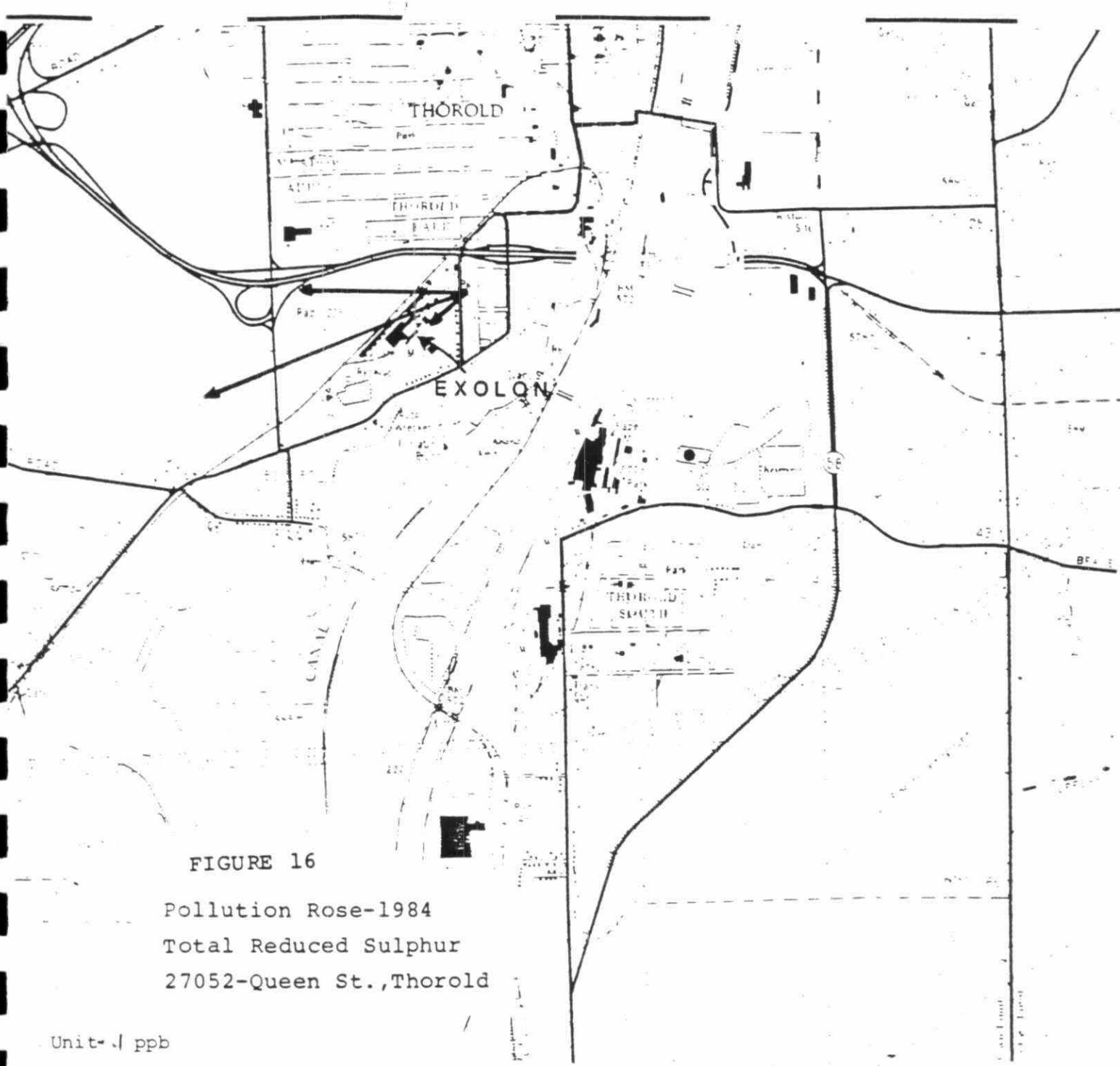


FIGURE 16

Pollution Rose-1984
Total Reduced Sulphur
27052-Queen St.,Thorold

Unit-ppb

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
2	2	5	4	6	15	10	4	4	7	47	253	150	16	4	3

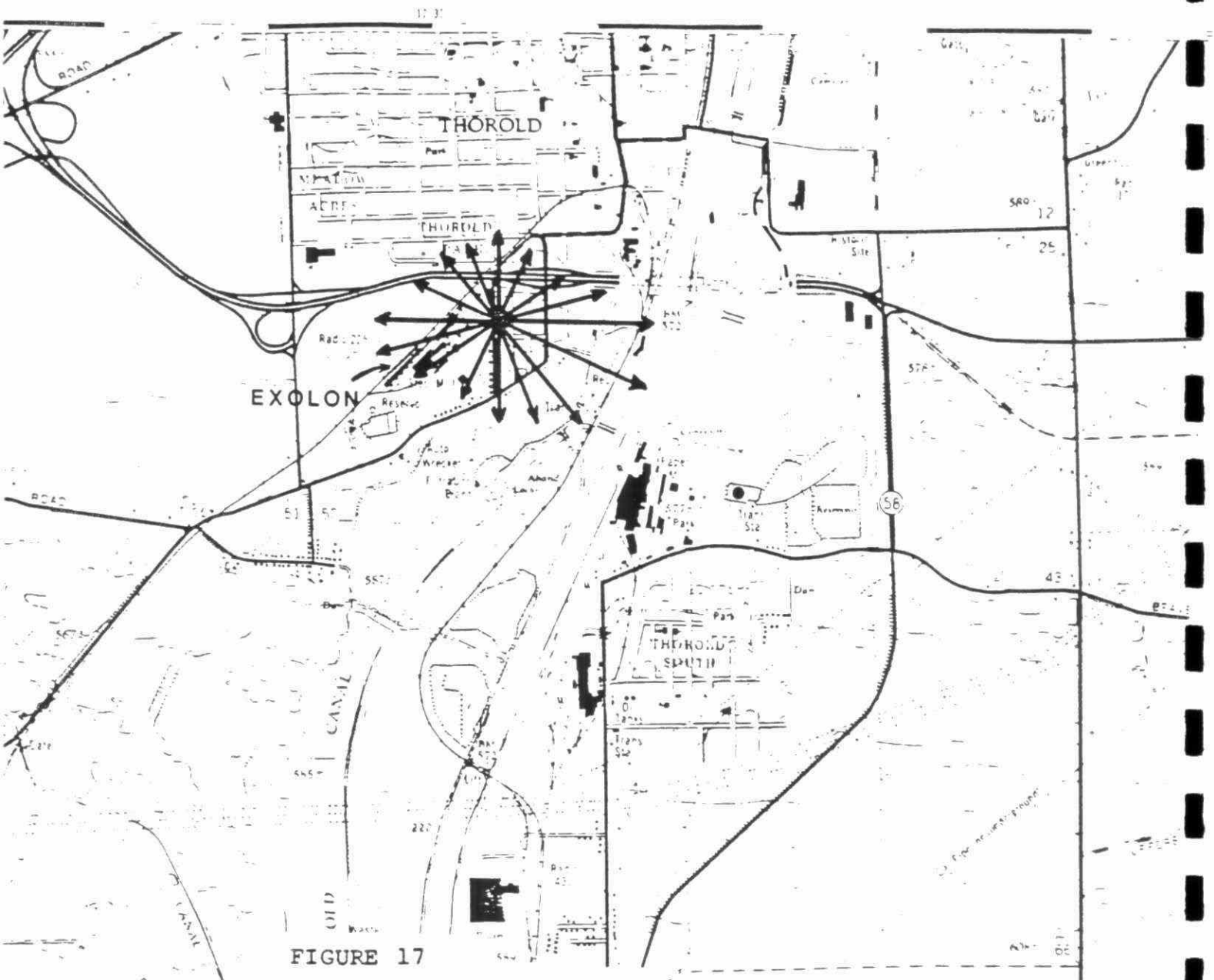


FIGURE 17

Pollution Rose - 1984
Soiling Index
27052 - Queen St.,Thorold

Unit - .01 COH's/1000 ft.

N.	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
30	26	26	37	51	54	44	36	34	28	34	43	42	31	29	29

TABLE 1
SULPHUR DIOXIDE
UNIT - PARTS PER MILLION

Ontario Objectives: 1-Hour - .25
24-Hour - .10
1-Year - .02

LOCATION	ANNUAL AVERAGE 1984	1983	1982	1984 MAXIMUM 1-Hour	24-Hour	NO. OF TIMES ABOVE OBJECTIVE (1984) 1-Hour	24-Hour	SOURCE MONITORED
27048 Niagara Public Works - Fort Erie	.005	.005	.007	.17	.03	0	0	Nanticoke Gen. Station
27056 Allendale Avenue Niagara Falls	.004	.003	.003	.11	.04	0	0	Ambient
27055 Stanley Street Niagara Falls	.002	.003[5]	-	.12	.02	0	0	General Abrasive Ltd.
27051 Norton/Portage Chippawa	.007	.007	.011	.18	.04	0	0	Norton Company
27037 North/Geneva St. Catharines	.005	.005	.005	.11	.05	0	0	General Ambient
27042 Niagara/Ontario Thorold	.002	.023	.012	.31	.04	2	0	Ontario Paper Ltd.
27052 Queen Street Thorold	.011	.016[5]	-	.18	.07	0	0	Exolon

5 - Numerical exponents refer to number of months sampled when less than 12

TABLE 2
TOTAL REDUCED SULPHUR
UNIT - PARTS PER BILLION

Ontario Objective: 1-Hour - 20 (Hydrogen Sulphide)

LOCATION	ANNUAL AVERAGE 1984	1983	1982	1984 MAXIMUM 1-Hour	NO. OF HOURS ABOVE OBJECTIVE (1984)	SOURCE MONITORED
27051 Norton/Portage Chippawa	1.4^{11}	0.2^{4}	5.5	224	78	Norton Co.
27052 Queen Street Thorold	4.5	5.8^{5}	-	254	567	Exolon
27055 Stanley Street Niagara Falls	0.8	0.8^{5}	-	36	4	General Abrasive Ltd.

5 - Numerical exponent refers to number of months sampled when less than 12.

TABLE 3
SOILING INDEX (COEFFICIENT OF HAZE)
UNIT - COH'S PER 1000 LINEAR FEET OF AIR

Ontario Objectives: 24-Hour - 1.0
1-Year - 0.5

LOCATION	ANNUAL AVERAGE 1984	1983	1982	1984 MAXIMUM 24-Hour	NO. OF TIMES OVER 24-Hour OBJECTIVE (1984)	SOURCE MONITORED
27056 Allendale Avenue Niagara Falls	.22	.18	.23	.9	0	Ambient
27037 North/Geneva St. Catharines	.24	.27	.29	1.2	1	Ambient
27055 Stanley Street Niagara Falls	.38	-	-	1.2	1	General Abrasive Ltd.
27052 Queen Street	.35[11]	-	-	1.2	1	Exolon

11 - Numerical exponent refers to number of months sampled when less than 12.

TABLE 4
OZONE
UNIT - PARTS PER BILLION

Ontario Objective: 1-Hour - 80

LOCATION	ANNUAL AVERAGE 1984	1983	1982	1984 MAXIMUM 1-Hour	NO. Of HOURS ABOVE OBJECTIVE (1984)	SOURCE MONITORED
27037 North/Geneva St. Catharines	20.3	23.2	21.2	113	19	Ambient/Long Range Transport

TABLE 5
CARBON MONOXIDE
UNIT - PARTS PER MILLION

Ontario Objectives: 1-Hour - 30
8-Hour - 13

LOCATION	ANNUAL AVERAGE 1984	1983	1982	1984 MAXIMUM 1-Hour	24-Hour	NO. Of TIMES OVER OBJECTIVE (1984) 1-Hour	8-Hour	SOURCE MONITORED
27037 North/Geneva St. Catharines	0.4	0.4	0.4	10	4	0	0	Ambient

TABLE 6
NITROGEN DIOXIDE
UNIT - PARTS PER MILLION

Ontario Objectives: 1-Hour - .20
24-Hour - .10

LOCATION	ANNUAL AVERAGE 1984	1983	1982	1984 MAXIMUM 1-Hour	24-Hour	NO. Of TIMES ABOVE OBJECTIVE (1984) 1-Hour	24-Hour	SOURCE MONITORED
27037 North/Geneva St. Catharines	.018	.020	.019	.09	.05	0	0	Ambient

TABLE 7
SUSPENDED PARTICULATES
UNIT - MICROGRAMS PER CUBIC METRE

Ontario Objective: 24-Hour - 120
1-Year Geo. Mean - 60

LOCATION	GEOMETRIC MEAN 1984	1983	1982	1984 MAXIMUM	% OF SAMPLES OVER 120 (1984)	SOURCE MONITORED
27056 Allendale Avenue Niagara Falls	48	50	54	156	2%	Ambient
27053 First/Bridge Niagara Falls	76	73	66^{8}	248	25%	Cyanamid
27055 Stanley Street Niagara Falls	103	68*	63^{6}	296	44%	General Abrasive Ltd.
27009 Norton/Portage Chippawa	73	69	67	202	14%	Norton Co.
27014 Stanley/Chippawa Chippawa	51	46	44	125	3%	Norton Co. Background
27030 Killaly/James Port Colborne	49	42	42	130	2%	INCO
27047 Davis/Fraser Port Colborne	57	51	42	134	5%	INCO
27008 King Street St. Catharines	57	57	52	157	2%	Ambient
27037 North/Geneva St. Catharines	58	68	56	200	4%	Ambient

8 - Numerical exponents refer to number of months sampled when less than 12.
* - Composite of 2 locations - station moved closer to source in July 1983.

TABLE 7 (cont'd)
SUSPENDED PARTICULATES
UNIT - MICROGRAMS PER CUBIC METRE

Ontario Objective: 24-Hour - 120
1-Year Geo. Mean - 60

LOCATION	GEOMETRIC MEAN 1984	1983	1982	1984 MAXIMUM	% OF SAMPLES OVER 120 (1984)	SOURCE MONITORED
27052 Queen Street Thorold	131	115	92^9	631	60%	Exolon
27045 Alberta/Devon Welland	58	49	53	172	2%	Union Carbide

9 - Numerical exponents refer to number of months sampled when less than 12.

TABLE 8
CONSTITUENTS IN SUSPENDED PARTICULATES
UNIT - MICROGRAMS PER CUBIC METRE

NICKEL - Ontario Objectives: 24-Hour - 2.0

LOCATION	GEOMETRIC MEAN 1984	1983	1982	1984 MAXIMUM	& OF SAMPLES OVER 2.0 (1984)	SOURCE MONITORED
27030 Killaly/James Port Colborne	.072	.057	.027	1.1	0	INCO
27047 Davis/Fraser Port Colborne	.071	.057	.055	2.4	2%	INCO

ELEMENTAL CARBON - Ontario Objective: None

27045 Alberta/Devon Welland	4.7	4.3	3.7	34.0		Union Carbide

TOTAL CARBON - Ontario Objective: None

27045 Alberta/Devon Welland	10.4	11.0	10.8	50.3		Union Carbide

TABLE 9
DUSTFALL
UNIT - GRAMS/SQUARE METRE/30 DAYS

Ontario Objectives: 1-Month - 7.0
1-Year - 4.5

LOCATION	ANNUAL AVERAGE 1984	1983	1982	1984 MAXIMUM 1-Month	NO. Of MONTHS ABOVE OBJECTIVE (1984)	SOURCE MONITORED
27005 Portage/Legion Chippawa	7.8^{11}	6.4^{11}	8.1	19.0	5	Norton Co.
27006 Bridgewater/Oliver Chippawa	3.5	3.3	4.0^{11}	7.1	1	Norton Co. Background
27040 Plymouth Avenue St. Catharines	11.3	9.8	10.3	41.3	8	Aimco Foundry
27041 Glendale/QEW St. Catharines	6.3	6.2	5.0	11.0	2	G. M. Foundry
27054 Catherine/Russel St. Catharines	8.0	7.2^{11}	8.7^{7}	30.4	4	Burnstein Foundry
27042 Niagara/Ontario Thorold	7.8	9.1	9.8	12.9	5	Ontario Paper
27043 McAdam Park Thorold	4.2^{9}	3.6	4.1^{10}	8.9	2	Ontario Paper Background
27025 Harriet Street Welland	4.9	4.5^{11}	4.6	10.3	1	Union Carbide
27026 Chaffey Street Welland	6.0	6.0^{11}	4.8	12.4	2	Union Carbide
27035 Alberta Street Welland	10.2	8.8	5.6	21.5	8	Union Carbide

11 - Exponents refer to number of valid monthly samples when less than 12.